

ARGUMENTS/REMARKS

Claims 1 through 4, 6 through 15 and 17 through 20 are pending in the present application. Claims 1, 6-7, 10, 11 and 16 through 18 have been amended to claim the full scope of the invention. Claims 5 and 16 have been canceled.

In the Office Action, claims 1, 3, 4, 14 and 15 were rejected under 35 U.S.C. 102(b) as being clearly anticipated by either U.S. Patent No. 4,204,872 to Hayati et al. (hereinafter “the Hayati et al. patent”), U.S. Patent No. 3,894,572 to Moore, Jr. (hereinafter “the Moore, Jr. patent”), or U.S. Patent No. 3,616,840 to Dunlop (hereinafter “the Dunlop patent”). Applicant respectfully disagrees.

Claim 1 is directed to a method for the production of a shell mould. Claim 1 provides for the steps of (i) dipping a preformed expendable pattern into a slurry of refractory particles and colloidal liquid binder whereby to form a coating layer on the pattern, (ii) depositing particles of refractory material onto the coating, and (iii) drying. Steps (i) to (iii) are repeated as often as required to produce a shell mould having a primary coating layer and at least one secondary coating layer, wherein during at least one performance of step (ii) a gel-forming material is also deposited onto the coating layer formed in step (i). After contact with the coating layer, moisture is absorbed by the gel-forming material thereby causing gelation of the colloidal binder so reducing the time required for drying in step (iii) wherein the gel-forming material is a super absorbent polymer.

Claim 14 directed to a shell mould. Claim 14 provides that the shell mould is produced by (i) dipping a preformed expendable pattern into a slurry of refractory particles and colloidal liquid binder whereby to form a coating layer on the pattern, (ii) depositing particles of refractory material onto the coating, and (iii) drying. Claim 14 also provides that steps (i) to (iii) are repeated as often as required to produce a shell mould having a primary coating layer and at least one secondary coating layer, wherein during at least one performance of step (ii) a gel-forming material is also deposited onto the coating layer formed in step (i), such that after contact with the coating layer,

moisture is absorbed by the gel-forming material thereby causing gelation of the colloidal binder so reducing the time required for drying in step (iii) wherein the gel-forming material is a super absorbent polymer.

Claim 15 is directed to an unfired precursor to a shell mould for producing a casting. Claim 15 provides for a precursor having a shell with a cavity therein in the shape of the casting. The shell has a plurality of layers, wherein at least one of the layers has a gel-forming material containing absorbed moisture, refractory particles and gelled colloidal liquid binder wherein the gel-forming material is a super absorbent polymer.

The Hayati et al. patent is directed to a preparation of high temperature shell molds. The Hayati et al. patent discloses a coating, stuccoing and drying sequence that is repeated until the desired coating thickness is achieved and then a sealing coat is applied, as desired.

The Moore, Jr. patent is directed to a process for forming a refractory laminate. The Moore, Jr. patent discloses a method of forming a refractory laminate on the surface of a support structure which comprises dipping the structure into a bath of a sol of positively charged colloidal particles form a coating on the surface, and applying to the surface a particulate refractory material containing a chemical setting agent.

The Dunlop patent is directed to a method of making multilayer shell molds. The Dunlop patent discloses shell molds that are prepared by repeatedly applying to a pattern a slurry containing sodium or potassium silicate, removing the pattern from the slurry and coating it with refractory material, and then applying a phosphorous-containing gelling agent until a desired thickness is achieved.

Claims 1, 14 and 15 have been amended to recite that the gel-forming material is a super absorbent polymer.

The office action states that claims 1 to 4, 9, 10, 14, 15 and 20 are clearly anticipated by at least one of Hayati, Moore Jr., and Dunlop. It is clear from the claim language that gelation of the colloidal binder must be caused by absorption of moisture by the gel-forming material. This feature is not disclosed in either the Hayati patent or the More patent.

In fact, Hayati does not disclose the addition of a gel-forming material to the liquid binder coat in the manner claimed at all. Rather, the passage in Hayati cited by the Examiner refers to the formation of a separate seal-coat (see column 2, lines 58 to 68) which is applied on top of a previously dried pre-coat (see column 5, lines 21 to 22). There is no disclosure of the application ('stucco') of refractory particles onto this seal coat, or of the use of a gelling agent together with refractory particles applied to a coating layer formed by dipping. As such, the method described in Hayati is clearly outside the scope of the present claims. Furthermore, there is nothing in the teaching of Hayati to suggest that the gelling agent causes gelation by the absorption of water. Rather, it is readily apparent to the skilled person that gelation is actually caused by a chemical reaction between the basic material (the 'gelling agent', such as ammonia) and the silicate ester used as a binder.

The gel-forming agent ('setting agent') in the Moore patent acts through electrostatic/chemical interaction of the negatively-charged setting agent with the positively-charged colloidal binder particles. There is absolutely no disclosure in the Moore patent of absorption of moisture by the gel forming material, let alone of initiation of gelation in this manner.

Regarding the Dunlop patent, applicant notes that the presently amended claims require the gel-forming material to be a super absorbent polymer. By contrast, the Dunlop patent discloses the use of phosphorous trichloride or phosphorous pentoxide, which are stated to act as desiccants. These substances cannot be considered to be polymers, and hence Dunlop cannot anticipate the amended claims, as acknowledged by the Examiner in relation to prior claim 5.

Neither the Hayati et al. patent, the Moore, Jr. patent, nor the Dunlop patent anticipate claims 1, 3, 4, 14 or 15. In particular, none of the cited prior art discloses that the gel forming material absorbs moisture following contact with the coating layer, thereby causing gelation of the colloidal binder. In contrast, any gelation in the cited prior art is produced by chemical reaction of the gel-forming material, rather than absorption of moisture. In the prior art, the coating material used to gel the colloid will react with the binder system and become an integral part of the shell's structure. This has undesirable consequences for the hot strength of the resulting shell.

In the Office Action, claims 2, 10 and 20 were rejected under 35 U.S.C. 102(b) as being clearly anticipated by the Hayati et al. patent. For the reasons set forth above with respect to claim 1, the Hayati et al. patent also does not anticipate claims 2 and 10 of the instant application.

In the Office Action, claim 9 was rejected under 35 U.S.C. as being clearly anticipated by the Moore, Jr. patent. For the reasons set forth above with respect to claim 1, above, the Moore, Jr. patent also does not anticipate claim 9 of the instant application. Reconsideration and withdrawal of the 35 U.S.C. 102(b) rejection are respectfully requested.

In the office action, claims 5 through 8, 11 through 13 and 16 through 19 were rejected under 35 U.S.C. 103(a) as being unpatentable over either Hayati et al., Moore, Jr. et al. or Dunlop. Claims 5 and 16 have been canceled by the present amendment and rejections with respect to these claims are hereby rendered moot.

In particular, office action alleges that it would be routine for one of ordinary skill to modify the teaching of these documents to arrive at the presently claimed invention. Applicant respectfully disagrees with the offered conclusion. In particular, as noted above, the process described in the Hayati patent is different than the presently claimed process. The difference between the claimed invention and that of Hayati is therefore rather more than the result of routine experimentation of substituting one gel-forming agent for another, but would rather require the substantial redesign of the

process. In particular, it is noted that the Hayati patent requires the binder composition to be substantially free from water (column 2, line 63). It is therefore submitted that there is no motivation for the skilled man to redesign the process of the Hayati patent in order to incorporate a gelling agent which works through absorption of moisture from the binder.

Similarly, in the Moore patent, the choice of gel forming material is critical, since it must be negatively charged in order to interact with the positively charged colloidal binder particles. The skilled person is therefore taught away from replacing the disclosed gel forming material with a super absorbent polymer such as that presently claimed.

With respect to the Dunlop patent, the present selection of a super absorbent polymer as gel forming material in place of the phosphorous compounds disclosed will result in a gel mould having a greater strength, and producing a better quality of casting, than that obtained by the method of the Dunlop patent. It is noted that the presence of chloride and/or phosphate ions within the shell mould, such as would be expected following the hydrolysis of phosphorous trichloride or pentoxide, can cause surface defects during light metal casting. Furthermore, the presence of phosphoric acid (such as would be obtained by hydrolysis of the phosphorous compounds used in Dunlop) can cause shell deformation during dewaxing and firing of the shell mould. Additionally, the use of phosphorous trichloride would lead to the presence of free hydrochloric acid, which, being volatile at temperatures used to remove the wax from the shell, would cause corrosion of equipment. Finally, the presence of free acids (such as hydrochloric or phosphoric acids) can be deleterious to metals in cast in the shell mould. These problems may be avoided through employment of the super absorbent polymer presently claimed. As such, it is submitted that the presently claimed invention is not merely a workshop modification of that disclosed in Dunlop, but rather achieves new and surprising benefits.

The Office Action states that it would have been obvious for those of ordinary skill in the casting art to select an appropriate gel-forming agent from among gel-forming materials for their investment molding process through routine experimentation. The

Office Action further states that it would also have been obvious to select a proper amount and particle size for the particular type of gel-forming material for the specific investment molding process. Applicants respectfully disagree.

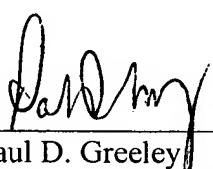
In particular, none of the cited prior art discloses that the gel forming material absorbs moisture following contact with the coating layer, thereby causing gelation of the colloidal binder. In contrast, any gelation in the cited prior art is produced by chemical reaction of the gel-forming material, rather than absorption of moisture. In the prior art, the coating material used to gel the colloid will react with the binder system and become an integral part of the shell's structure. This has undesirable consequences for the hot strength of the resulting shell. For at least these reasons, claims 6 through 8, 11 through 13 and 17 through 19 are not obvious in view of the prior art.

Claims 1 through 19 were provisionally rejected on the ground of non-statutory double patenting. Upon the allowance on the present application, Applicants will consider filing a terminal disclaimer should the application grant.

Consideration and allowance of application is respectfully requested.

Respectfully submitted,

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Date



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